



UNITED STATES DEPARTMENT OF COMMERCE  
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SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
06/843,454	03/24/86	BLANCHARD	11-300

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EXAMINER	
THOMAS, T	
ART UNIT	PAPER NUMBER
114	6

DATE MAILED: 06/22/87

This is a communication from the examiner in charge of your application.

COMMISSIONER OF PATENTS AND TRADEMARKS

☐ This application has been examined ☒ Responsive to communication filed on 3-30-87 ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), — days from the date of this letter.  
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

- |   |   |
|---|---|
| 1. <input checked="" type="checkbox"/> Notice of References Cited by Examiner, PTO-892. | 2. <input type="checkbox"/> Notice re Patent Drawing, PTO-948.                  |
| 3. <input checked="" type="checkbox"/> Notice of Art Cited by Applicant, PTO-1449       | 4. <input type="checkbox"/> Notice of informal Patent Application, Form PTO-152 |
| 5. <input type="checkbox"/> Information on How to Effect Drawing Changes, PTO-1474      | 6. <input type="checkbox"/> _____   |

Part II SUMMARY OF ACTION

1. ☐ Claims 8 — 16 are pending in the application.  
Of the above, claims \_\_\_\_\_ are withdrawn from consideration.
2. ☐ Claims \_\_\_\_\_ have been cancelled.
3. ☐ Claims \_\_\_\_\_ are allowed.
4. ☒ Claims 8-16 are rejected.
5. ☐ Claims \_\_\_\_\_ are objected to.
6. ☐ Claims \_\_\_\_\_ are subject to restriction or election requirement.
7. ☐ This application has been filed with informal drawings which are acceptable for examination purposes until such time as allowable subject matter is indicated.
8. ☐ Allowable subject matter having been indicated, formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on \_\_\_\_\_. These drawings are ☐ acceptable; ☐ not acceptable (see explanation).
10. ☐ The ☐ proposed drawing correction and/or the ☐ proposed additional or substitute sheet(s) of drawings, filed on \_\_\_\_\_, has (have) been ☐ approved by the examiner. ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed \_\_\_\_\_, has been ☐ approved. ☐ disapproved (see explanation). However, the Patent and Trademark Office no longer makes drawing changes. It is now applicant's responsibility to ensure that the drawings are corrected. Corrections MUST be effected in accordance with the instructions set forth on the attached letter "INFORMATION ON HOW TO EFFECT DRAWING CHANGES", PTO-1474.
12. ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received ☐ not been received  
☐ been filed in parent application, serial no. \_\_\_\_\_; filed on \_\_\_\_\_.
13. ☐ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

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Remarks and amendments contained in letter dated 3-30-87 have been considered carefully.

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification is objected to under 35 U.S.C. 112, first paragraph, as failing to provide best mode of carrying out invention.

The process of forming gate contact 49 through oxide layer 35 to gate is not described at all. It is not clear from specification page 6, line 20+ how the applicants fit the contact wire 34 inside the polysilicon filler, and oxidize the top of the filler. Examiner would like to know how the structure of Fig. 7 is obtained from that of Fig. 5, is it by forcing down a metal wire through oxide layer (35) to polysilicon filler. This rejection is of record in paper no. 2 mailed 12-31-86.

Claims 8-16 are rejected under 35 U.S.C. 112, first paragraph, for the reasons set forth in the above objection to the specification.

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the

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subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Subject matter developed by another person, which qualifies as prior art only under subsection (f) and (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

Claims 8-16 are rejected under 35 U.S.C. 103 as being unpatentable over Schutten et al. in view of Arnould et al.

Schutten et al. discloses a method of making power semiconductor device by filling insulator lined U-groove with conductor material. (See Fig. 2, 13, and col. 6, lines 57+, and col. 4, lines 1-41). Schutten et al. lacks anticipation only in not forming insulator layer over the conductive gate filler.

It is a very common practice in semiconductor device technology to form insulator regions to isolate source/drain regions from gate. Etching down polysilicon filler in the trench and oxidizing top layer to planarize and/or insulate filler from other metallization is also well known in the art. Arnould et al teaches forming an electrode in u-groove by filling insulator lined groove with conductive material, and subsequently forming an insulating layer over the conductive filler (See col. 2, lines 20-29, col. 3-6 and Figs. 5-12).

Accordingly it would have been obvious to one

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having ordinary skill in the art to modify Schutten's trench gate process by forming an insulator layer over the gate since it would avoid shorting between source/drain, and gate and in addition it would avoid shorting between metallization and gate conductor.

Claims 8-16 are rejected under 35 U.S.C. 103 as being unpatentable over admitted prior art in view of Iwai, Furumura, and Arnould et al.

The admitted prior art lacks anticipation only in filling up the groove with polysilicon and planarizing it.

Furumura teaches forming a MOS gate structure by filling insulator lined groove with conductive material, but fails to teach forming insulator layer over gate material (See Abstract and Figures) in U-groove. Iwai does not teach forming insulator layer over gate filler. (See Figs. 4a-4b, Figs. 5-7 and accompanying text).

Arnould et al. teaches forming an electrode in U-groove by filling insulator lined U-groove with conductive material, and subsequently forming a insulating layer at top of the conductive filler. (See col. 2, lines 20-29 col. 3-6, Fig. 5-12). It is obvious that insulator layer on top of trench filler is an effective insulation between metal interconnect lines and trench filler. It is well known that planarization of substrate surface is necessary to prevent breaks in metal interconnect lines.

Accordingly it would have been obvious to one of ordinary skill in the art to use Arnould's planarization

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process in admittedly prior U-groove FET-process since it will provide a flat substrate surface preventing breaks in metallization and further provide effective insulation between source/drain region, or metal interconnect lines, and gate.

Applicant is requested to further define prior art and submit printed documents if any.

Applicant's arguments with respect to claim have been considered but are deemed to be moot in view of the new grounds of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tom Thomas whose telephone number is (703) 557-5918.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 557-2517.

TThomas:tp

06/18/87



BRIAN E. HEARN  
SUPERVISORY PRIMARY EXAMINER  
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